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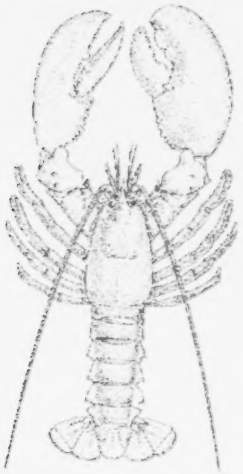
Quebec Region
Canadian Science Advisory Secretariat
Science Advisory Report 2012/015

ASSESSMENT OF LOBSTER STOCKS OF THE GASPÉ (LFAS 19, 20 AND 21), QUEBEC, IN 2011



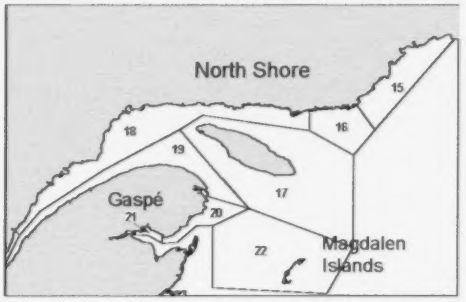


Figure 1: Map showing the lobster fishing areas (LFAs) in Quebec (LFAs 15 to 18: North Shore and Anticosti, LFAs 19 to 21: Gaspé Peninsula and LFA 22: Magdalen Islands).

Context

Lobster fishing in the Gaspé Peninsula is practiced by 180 enterprises (a skipper-owner and one or more fishers' helpers). The fishing effort is distributed among three lobster fishing areas (LFAs 19, 20 and 21) (Figure 1) subdivided into 27 sub-areas (Figure 2). LFA 20 has the most licences—94% of the total number in the Gaspé Peninsula. A small fleet (eight enterprises) fishes along the north shore of the Peninsula (LFA 19) between Forillon and Grande-Vallée. In LFA 21, there are 12 commercial enterprises. In Area 21B, the Listuguj Micmacs fish for subsistence in the fall. The fishery is managed by controlling the fishing effort (number of licenses, number and size of traps, fishing season and daily schedule, organization of trap lines) and by escapement measures: minimum and maximum legal sizes, release of berried females and release of females with a V-notch on their uropods, marked in this way by fishers on a voluntary basis. The management and conservation measures introduced over the past 15 years follow the recommendations of the Fisheries Resource Conservation Council (FRCC). The resource status is assessed every three years. This report describes the situation in 2011 and the changes observed since the last stock status assessment in 2008.

SUMMARY

- The **abundance indicators** have increased since 2008. The 2011 landings were 15% higher compared to 2008, reaching 872 t, and 6% above the average of the past 25 years. In 2011, 92% of the landings in the Gaspé Peninsula came from LFA 20, 5% from LFA 21 and 3% from LFA 19. In LFA 20, catches per unit effort (CPUE) were higher than in 2008 and above the data series average. CPUEs in Area 19C fluctuate with no clear trend, but are still high.

Canada

- In LFA 20, the **demographic indicators** show that the average size of commercial lobster has changed little since 2008. The sex ratio is generally stable and balanced. Size structures are highly truncated and characterized by very few (< 1%) jumbo lobsters (≥ 127 mm carapace length, CL). In LFA 19C, the size structures are much broader and the proportion of jumbos has been near 6% since 2008. The average size of commercial lobsters in this area remains very high and stable. The sex ratio favours males.
- The **fishing pressure indicators** show that exploitation rates generally remained high in LFA 20. However, a drop in these rates was noted in some sub-areas where there was a noticeable decrease in fishing effort. Since 2004, fishing mortality for the portion of the population ≥ 76 mm CL has dropped as a result of the increase in the minimum legal size. The exploitation rate is much lower in LFA 19C than elsewhere in the Gaspé.
- **Productivity indicators** are high in LFA 20. The abundance of berried females, egg production and recruitment were higher in 2011 than in 2008. Prerecruit abundance was high in 2011, suggesting that recent landing levels could be maintained in 2012.
- In LFA 20, fishing effort has declined in recent years. The good performance of stock status indicators is probably attributable to the drop. Therefore, continuing to reduce the fishing effort to decrease exploitation rates and improve size structures, increasing the proportion of multiparous females and keeping the sex ratio balanced are all recommended. It appears important to define biological reference points for the development of a precautionary approach.
- Landings doubled in LFA 21A between 2008 and 2011. In LFA 21B, the combined catches from the fall fishery and the spring fishery of the following year have increased since 2006. It is recommended that fishing effort continue to be controlled in LFA 21B and that the minimum legal size be maintained at 82 mm.

INTRODUCTION

Biology

American lobster (*Homarus americanus*) occurs along the west coast of the Atlantic Ocean, from Labrador to Cape Hatteras. Adult lobsters prefer rocky substrates where they can find shelter, but can also live on sandy and even muddy bottoms. Commercial concentrations are generally found at depths of less than 35 m. Females reach sexual maturity at around 82 mm carapace length, CL in the southern part of the Gaspé Peninsula. The examination of size structures of berried females suggests that they reach sexual maturity at a larger size along the north shore of the Peninsula. Males reach sexual maturity at a smaller size. Females generally have a two-year reproductive cycle, spawning one year and moulting the next. Females spawning for the first time can produce nearly 8 000 eggs while large females measuring 127 mm CL (jumbo size) can lay up to 35 000 eggs. In addition to being more fertile, certain large females could spawn for two consecutive years before moulting. Once released, the eggs remain attached to the females' swimmerets for 9 to 12 months, until the planktonic larvae hatch the following summer. Spawning and hatching can occur earlier in the season for multiparous females (females spawning for the second time at least) than for primiparous females. It was also noticed that larvae at the time of release could be larger for multiparous females than for primiparous females. The larvae's planktonic phase lasts from 3 to 10 weeks, depending on the temperature of the water. Following metamorphosis, postlarval lobsters (stage IV), which now resemble adult lobsters, drift down from the surface layer to settle on the sea floor. The survival of lobster from their larval stage to their initial benthic stages is impacted by predation as well as by hydrodynamic factors that cause

advection or retain the larvae near the areas that are favourable for benthic settlement. During the first few years of benthic life, until they reach approximately 40 mm, lobsters lead a cryptic existence; i.e. they live hidden in habitat providing many shelters. Lobsters are estimated to reach the minimum legal size (82 mm or 83 mm) at around eight or nine years of age after having moulted approximately 16 times since their benthic settlement.

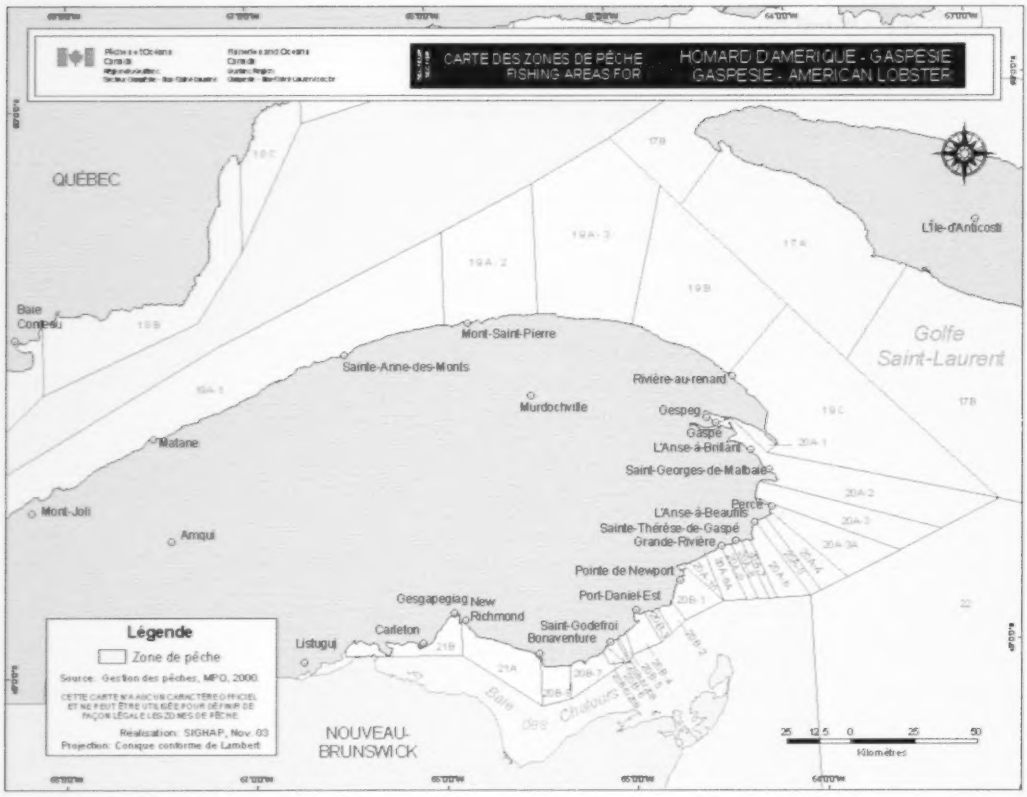


Figure 2. Map of the Gaspé Peninsula showing the different sub-areas of LFA 19 (19A1 to 19C), LFA 20 (20A1 to 20A10 and 20B1 to 20B8) and LFA 21 (21A and 21B).

Description of the fishery

The lobster fishery is managed by controlling fishing effort that restricts the number of licences, the number and size of traps and the duration of the fishing season. In the Gaspé, the lobster fishery is a spring activity that lasts 69 days (LFAs 20 and 21) and 71 days (LFA 19). In 2011, 180 commercial licences were issued with a limitation of 235 (LFAs 20 and 21) and 250 traps each (LFA 19). In addition to the size of the traps, which is limited to 92 cm in length, 61 cm in width and 50 cm in height, the presence of escape vents has been mandatory since 1994 and the size of their vertical opening went from 43 mm to 46 mm in 2004 to comply with the introduction of the new minimum legal size of 82 mm. Traps cannot be hauled more than once a day. In 2006, the number of traps went from 250 to 235 per fisher in LFAs 20 and 21 and the fishing season was shortened by two days, from 71 to 69. Moreover, a number of initiatives to buy back licences have been put forward and since 2003, 38 of 218 licences have been removed. The buybacks were mainly in areas where yields were low, as in sub-areas 20B5–B6, where 13 of 30 licences (36%) were removed. In 2011, the nominal effort expressed in number of

trap hauls was estimated at 2.26 million for LFA 20, which is 26% below the 1994–2005 average (3 million trap hauls).

Fishery management also includes escapement measures. In addition to having a minimum legal size (MLS, carapace length), berried females must be released. Starting in 1997, the MLS was increased by 1–2 mm every 1–2 years over eight years. It reached 82 mm in 2004 in LFAs 20 and 21 and 83 mm in 2006 in LFA 19. It was 76 mm between 1957 and 1996. The objective of increasing the MLS was to double the 1996 level of egg production per recruit. On a voluntary basis, fishers mark berried females by V-notching their uropods. The number of V-notched berried females varies and is not monitored. However, their release is mandatory. In 2008, a maximum catch size of 155 mm CL was implemented in LFA 20. That size has been 150 mm CL since 2009.

STOCK STATUS ASSESSMENT

Source of data

The stock status assessment is based on indicators of abundance, demographics, fishing pressure and stock productivity. Abundance indicators include landings recorded on processing plant purchase slips and catch rates of commercial-size lobsters obtained mainly from at-sea samplings of commercial catches. The demographic indicators are taken from the lobster size structures and include mean size and weight, jumbo abundance, and sex ratios. The fishing pressure index (exploitation rate) is derived from a measurement of the ratio between the number of individuals (males) from the first moult class recruited to the fishery in a given year and that of the second moult class recruited to the fishery one year later. Productivity indicators are based on abundance of berried females and on egg production (reproduction) as well as on abundance of prerecruits (recruitment). At-sea sampling has been conducted on board fishing vessels since 1986 at La Malbaie (20A2), Ste-Thérèse/Grande-Rivière (20A8–A9) and Shigawake/St-Godefroi (20B5–B6). It was also carried out from 1997 to 2004 in 21B during the spring fishery, from 2002 to 2004 during the fall fishery, and from 2000 to 2004 and in 2011 in 19C. Since 2005, dockside sampling has replaced at-sea sampling in areas 21B and 19C. From 2008 to 2010, Parks Canada did additional sampling at sea in the Forillon National Park area (19C and 20A1)

Since 2006, 25–35 fishers have participated in a project to develop a recruitment index. Participants are allowed to use two lobster traps modified by closing the escape vents and two regular traps placed alternately on a fishing line. They collect data on the number and size (with a special gauge) of lobster caught. The abundance of prerecruits is to be used as an index of recruitment to the fishery one and two years in advance. Data obtained on commercial-size lobsters and on berried females in this project are also considered in the assessment. In 2011, a postseason (September) survey using modified traps (without escape vents) was conducted at five sites in the Gaspé (LFA 20) in order to develop a new index of recruitment to the fishery.

For each indicator, data from the three previous years are examined and the 2011 data are compared to 2008 and the averages from the existing data series before 2011.

Abundance indicators

Landings

Landings for the whole of the Gaspé Peninsula reached 872 t in 2011 (preliminary data) (Figure 3). They increased by 14.8% compared to 2008 (786 t). In 2011, they were 6% above the

average of the past 25 years (1986–2010) (823 t). Also that year, 92% of the Gaspé landings were from LFA 20, 3% from LFA 19 and 5% from LFA 21. Landings from the Gaspé accounted for 23.4% of total Quebec landings (3 716 t). In LFA 20, landings in 2011 reached 805 t, an increase of 8% compared to 2008 (739 t) and 6% compared to the average of the past 25 years (761 t). The upward trend observed since 2008 was noted in most of the sub-areas in LFA 20. Landings from that area dropped significantly between 1999 and 2005 and did not increase between 2005 and 2008. Landings in LFA 19 reached 28 t in 2011, just as they did in 2008 (Figure 3). The average of the past 25 years in LFA 19 is 26 t. Landings in LFA 21A more than doubled between 2008 (16 t) and 2011 (36 t) (Figure 3). In Area 21B, combined landings from the fall fishery and the spring fishery of the following year increased from 5 to 12 t between 2006 and 2011 (Figure 3). The drop in spring landings since 2004 is related to a drop in fishing effort. Fall landings have increased since 2006.

Catch rates for commercial-size lobsters

Catch rates correspond to the catches per unit of effort (CPUEs) expressed in number or weight of lobster per trap. In 2011, the CPUE for commercial-size lobsters in LFA 20 was 0.58 per trap, which corresponds to a weight of 0.35 kg/trap (Figures 4A and 4B). The CPUE in number in 2011 was 32% higher than that in 2008 and 9.4% above the series average (1985 to 2010) (0.53 lobster/trap, or l/trap). The CPUE in weight was 34.6% higher than that in 2008 and 39.6% above the series average (0.27 kg/trap). An increase in CPUEs was observed in the three groups of sub-areas sampled, especially in 20B5–B6. CPUE values obtained from the recruitment project also showed an upward trend between 2006 and 2011 (Figures 4A and 4B). The values presented are those obtained with regular traps.

CPUEs in Area 19 were 0.59 l/trap and 0.48 kg/trap in 2011, which is 8% and 6% lower than in 2008 (Figures 4C and 4D). However, the values fluctuate considerably from one year to the next. The average CPUE measured during the fall fishery in LFA 21B was 2.1 kg/trap (Figure 4E). This is the highest value observed since the start of the fall fishery in 2001. The 2001–2011 average was 1.2 kg/trap and these high values reflect the highest catchability of lobster in the fall. Traditionally, average CPUEs observed during the spring fishery are about 0.2 kg/trap.

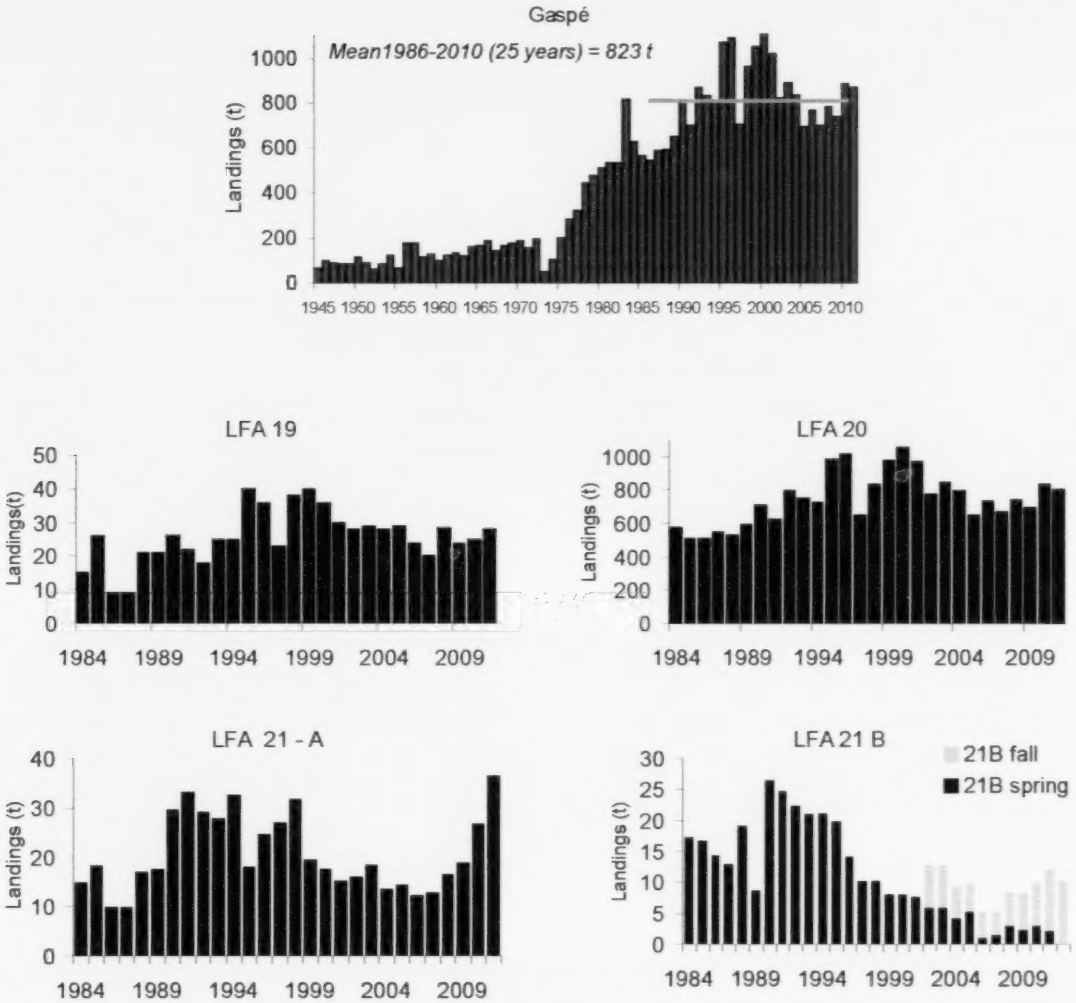


Figure 3. Lobster landings in the Gaspé from 1945 to 2011 and from 1984 to 2011 for LFAs 19, 20, 21A and 21B.

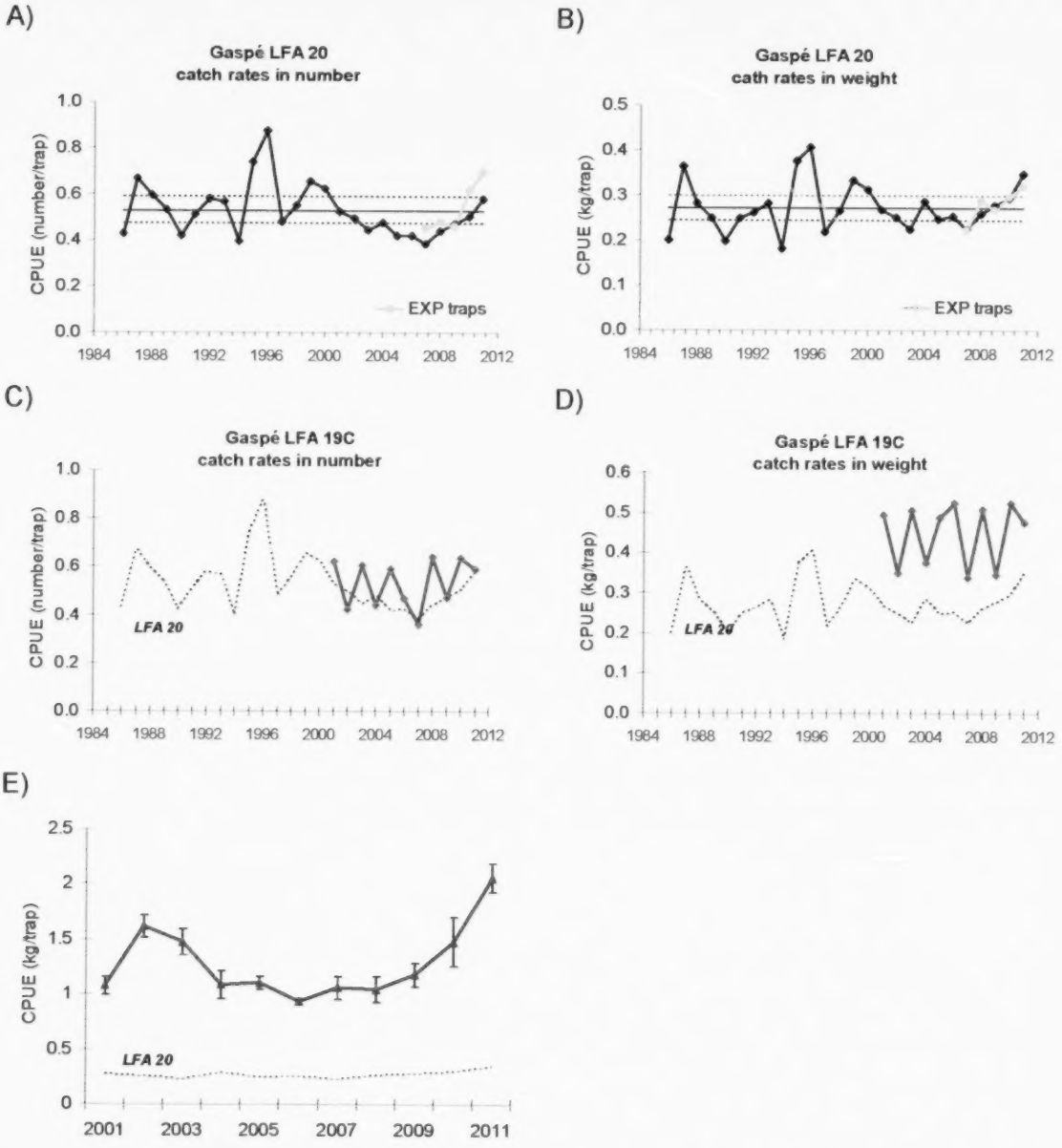


Figure 4. Catch rates (CPUE) of commercial-size lobsters for LFA 20 in the Gaspé from 1986 to 2011 in number (A) and weight (B) per trap, for LFA 19C from 2001 to 2011 in number (C) and weight (D) and for LFA 21B in the fall in kg/trap ± standard error (E). For (A) and (B), 1986–2010 mean (solid line) ± 0.5 standard deviation (dotted lines). The grey lines represent CPUEs reported by fishers in LFA 20 who participated in the 2007–2011 recruitment project. For (C), (D) and (E), the dotted line represents CPUEs in LFA 20.

Demographic indicators

There was no notable change in commercial-size (≥ 82 mm) lobster size structures since 2008 in LFA 20 (Figure 5A) or since the MLS was increased in 2004. The size structures have a truncated appearance and are dominated by a moult class of 82–93 mm for males and 82–89 mm for females corresponding to the year's recruits. Female size distributions are more truncated toward small sizes than male size distributions are. This reflects a decrease in the growth of females as they reach sexual maturity. The mean size and weight of landed lobsters has remained stable since 2008 at around 88 mm and 560 g. The proportion of jumbo lobsters observed in at-sea sampling is quite low. It fluctuated between 0.2% and 0.3% between 2008 and 2011.

Size structures are more spread out in LFA 19C compared to LFA 20 (Figure 5B). Several moult classes are recognized there. The proportion of jumbo lobsters observed is also much higher there. It was 6% in 2011 and has fluctuated between 5% and 6% since 2008. The mean size and weight of landed lobsters has remained stable since 2008 (around 98 mm and 850 g).

The mean size of landed lobsters in LFA 21B (dockside sampling) in 2011 was 91 mm in spring and fall. Size structures are slightly less truncated than those observed in LFA 20. From 2008 to 2011, no jumbo lobsters were observed in the samples.

Fishing pressure and sex ratio

Truncated size structures are indicative of high exploitation rates. Exploitation rates calculated for the commercial-size males in LFA 20 (cohort monitoring) were 83% in 2010. They were 86% in 2008. These values are above the 1986–2009 series average of 76%. The exploitation rate index for males ≥ 76 mm CL has decreased to about 50–60% since the minimum legal size of 82 mm was reached.

Overall, female mortality is not as high because they are protected when berried. As a result, the sex ratio for lobsters left on the sea floor could swing in the females' favour, more so when exploitation rates are high. For now, in LFA 20, the sex ratio (number of males/number of non-berried females) seems appropriate to ensure mating (≥ 1).

The situation is different in LFA 19C, where spread-out size structures indicate that exploitation rates are lower (around 30%). Since 2008, sex ratios have always been over one and seem suitable for mating. In LFA 21B, size structures indicate that exploitation rates are somewhat high (not estimated). The sex ratios observed over the past few years were quite often widely in favour of males (> 2.0).

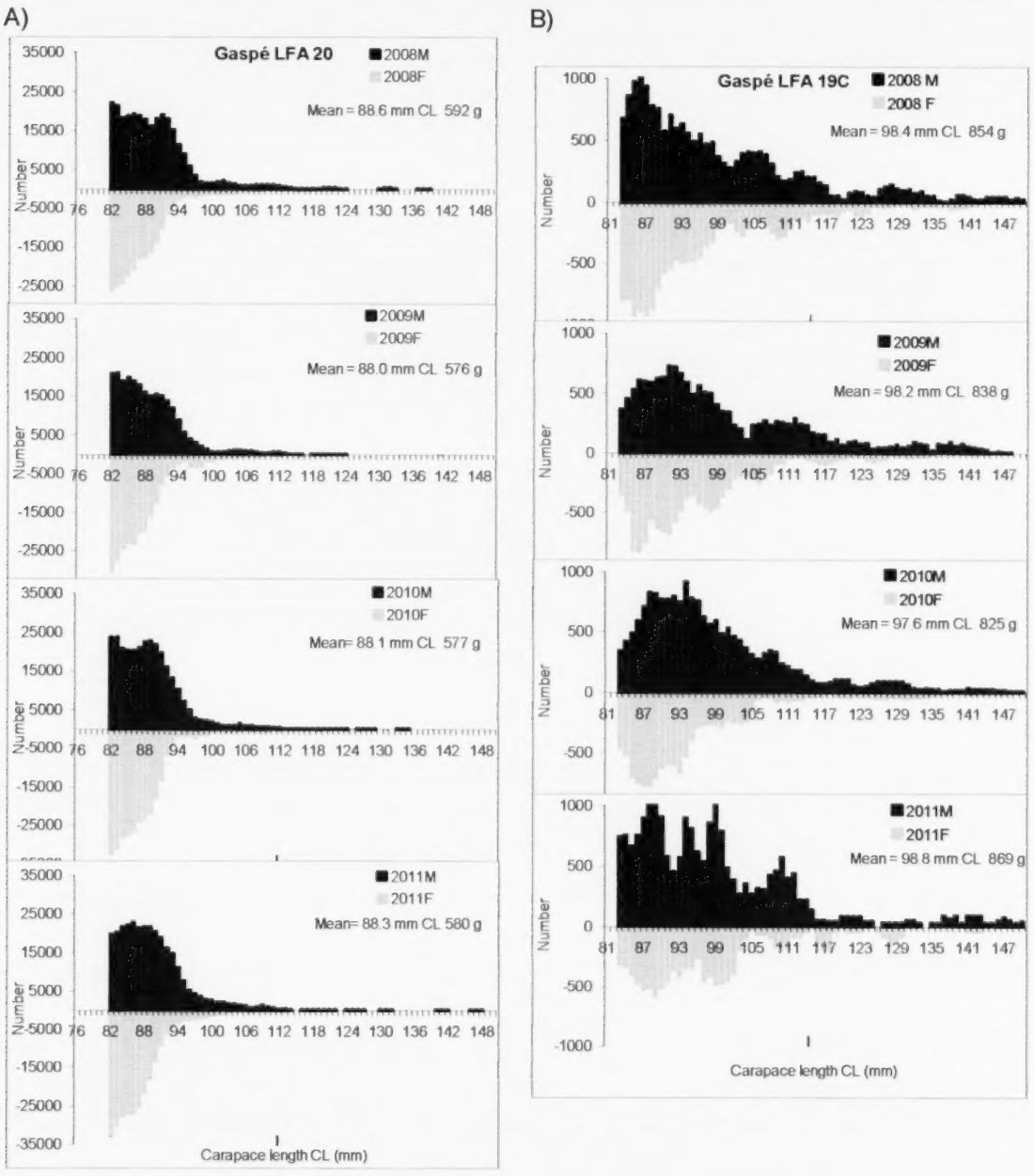


Figure 5. Size frequency distributions of male lobsters (black) and female lobsters (grey) (commercial portion) in the Gaspé from 2008 to 2011 for (A) LFA 20 and (B) LFA 19. The frequencies are in numbers weighted by landings.

Productivity indicators

Berried females and egg production

In 2011 in LFA 20, the CPUE for berried females reached 0.25 l/trap compared to 0.2 l/trap in 2008. Since then, the abundance of berried females has been at least three times higher than it was when the MLS was 76 mm (Figure 6A). The average CPUE from 1986 to 1996 was 0.06 l/trap. CPUE values obtained in the recruitment project where experimental traps were used have also shown an upward trend since 2007 (Figure 6A). The values are from modified traps (without escape vents), which explains why they are higher than the values from at-sea sampling. In LFA 19C, the abundance of berried females has fluctuated over the years without showing any clear trend (Figure 6B). The increase in the MLS had less of an impact on berried females than it did in LFA 20 because of a higher size at sexual maturity.

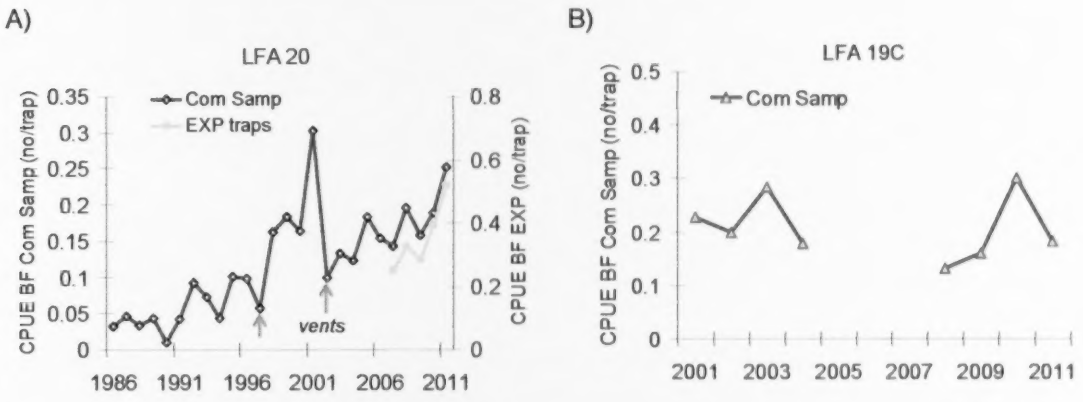


Figure 6. Catch rates (CPUE) of berried females (BF) in LFA 20 from 1986 to 2011 (A) and in LFA 19C from 2001 to 2004 and 2008 to 2011 (B). For (A), the first arrow indicates the start of the increase in minimum legal size and the second arrow indicates the year when the height of the escape vents was increased from 43 mm to 46 mm. Data from commercial at-sea sampling (Com Samp) and from the recruitment project (EXP traps).

The examination of size structures of berried females in LFA 20 shows a strong mode under the MLS (Figure 7A). A total of 66% of berried females are sublegal. Before the MLS was increased, most of these females did not contribute to egg production. In 2011, the average size of berried females was 81.3 mm CL. Also that year, multiparous females (those that spawn for at least a second time) represented 13% of berried females. An egg production index was obtained by multiplying the abundance index of berried females for each 1-mm size class by the size-specific fecundity. In 2011, the egg production index for all of LFA 20 was 3.1 times higher than that calculated for 1994 to 1996, before the increase in the MLS. Also that year, multiparous females contributed to 21% of total egg production.

The size structures of berried females in LFA 19C clearly differ from those in LFA 20 (Figure 7B). Because of lower exploitation rates, a wider range of sizes is observed. The percentage of sublegal berried females (10%) is much lower than it is in LFA 20. The average size of berried females measured in 2011 was 96.6 mm. There is also a non-negligible portion of jumbo females (4%).

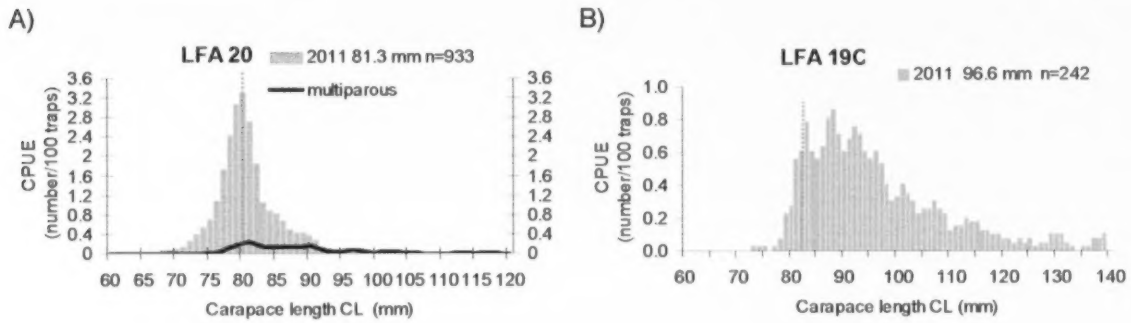


Figure 7. Size frequency distribution of berried females in 2011 in LFA 20 (A) and LFA 19C (B). The black line represents multiparous females. The distributions are weighted by abundance indices (annual CPUE). The average size and total number of berried females measured are indicated. The dotted line indicates MLS.

Recruitment

Abundance indices of prerecruits (70–81 mm, one moult below commercial size) from modified traps (closed escape vents) have increased since 2007 in LFA 20 (Figure 8). There is considerable spatial heterogeneity in the abundance of prerecruits in the Gaspé, but the upward trend was observed in most of the 12 sub-areas covered by the study. Generally, there is a positive relationship between the abundance of prerecruits in one year and commercial-size lobsters in the following year. However, the relationship can vary with sub-area. On the whole, the abundance of prerecruits observed in 2011 suggests that landings observed over the past two years could be maintained in 2012. The medium-term outlook (two years) is still inaccurate because of the short data series. Another index of recruitment to the fishery is currently being developed and is based on a postseason survey. The survey is conducted in the fall after moulting and the population sampled represents that which is available to the fishery in the following year. In 2011, traps with closed vents were used to collect data on the abundance of prerecruits at 245 stations in five sub-areas of LFA 20. The development of a time series (5–10 years) should, in the medium term (five years), establish a connection between the abundance of prerecruits one year and landings one or two years later. Since 2008, SCUBA diving surveys have been conducted to locate lobster nurseries. About 70 km of coastline were explored between St-Godefroi and Douglastown. Several nurseries were found in this area. Monitoring of the abundance of lobster in some of those nurseries could help in the development of an index of recruitment to the fishery in the longer term.

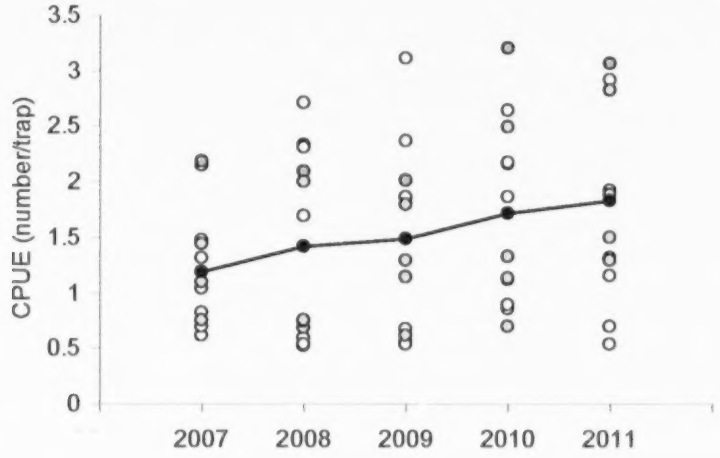


Figure 8. Catch rates (CPUE) of prerecruits (70–81 mm one moult below commercial size) from 2007 to 2011 for sub-areas 20A (empty circles), 20B (grey circles) and all of LFA 20 (black circles and black line). Data from experimental traps (closed vents).

Ecosystem considerations

Although lobster traps can be very selective, some non-targeted species that enter them are brought to the surface and returned to the water. An inventory of bycatches was taken during the 2011 lobster season. There was a total of 6 and 12 fishing trips in LFAs 19 and 20, respectively, during which all bycatch species were identified, counted and weighed. A total of 18 species were listed. Bycatches during the 2011 lobster season were estimated at 27 t in LFA 19 and 121 t in LFA 20; this represents about 121 and 14.5% of lobster landings, respectively. In LFA 19, Rock Crab made up almost 90% of the catches (in weight). Starfish and Hermit Crab were also observed, but in lesser quantities. In LFA 20, Rock Crab and Green Sea Urchin made up over 80% of the catches (in weight). Atlantic Cod, sculpin, Ocean Pout and *Hyas* sp. crab each made up about 3% of the catches. For most (except maybe Rock Crab, which can be landed), bycatches were returned to the water alive. Atlantic Cod is a species listed by COSEWIC as endangered.

Sources of uncertainty

Coverage of at-sea sampling is poor (0.13% of fishing activities), which brings about uncertainties in the representativeness of the estimates. Although it is considered that catch rates (CPUE) reflect lobster abundance on the sea floors, they can also be affected by catchability variations that bring about uncertainty in their interpretation. Changes in catchability can also create uncertainty in the calculation of exploitation rate indices. Spatial fishing patterns can affect the abundance index of berried females if, for example, fishers avoid areas where these females can gather.

CONCLUSION

The situation in LFAs 19, 20 and 21 in 2011 was positive. Abundance and productivity indicators have increased since 2008. In LFA 20, the fishing effort has dropped over the past few years. The good performance of stock status indicators is likely a result of this drop, mainly in sub-areas where the decrease in fishing effort was significant (> 30%). Therefore, continuing to reduce the fishing effort to decrease exploitation rates and improve size structures, increasing the proportion of multiparous females and keeping the sex ratio balanced are all recommended. It also appears important to define biological reference points for the development of a precautionary approach.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 1–2, 2012, assessment of the lobster in the Quebec's inshore waters. Additional publications from this process will be posted as they become available on the Fisheries and Oceans Canada Science Advisory Schedule at www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

Gendron, L. and G. Savard. 2012. Lobster Stock Status in the Coastal Waters of Quebec (LFAs 15 to 22) in 2011 and Determination of Reference Points for the Implementation of a Precautionary Approach in the Magdalen Islands (LFA 22). DFO Can. Sci. Advis. Sec. Res. Doc. 2012/10.

FOR MORE INFORMATION

Contact: Louise Gendron
Maurice Lamontagne Institute
850 Route de la Mer
P.O. Box 1000
Mont-Joli, QC
G5H 3Z4

Telephone: 418-775-0618
Fax: 418-775-0740
Email: louise.gendron@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Quebec Region
Fisheries and Oceans Canada
Maurice Lamontagne Institute
P.O. Box 1000
Mont-Joli, QC (Canada)
G5H 3Z4

Telephone: 418-775-0825
Fax: 418-775-0679
Email: bras@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs

ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)
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CORRECT CITATION FOR THIS PUBLICATION

DFO. 2012. Assessment of Lobster Stocks of the Gaspé (LFAs 19, 20 and 21), Quebec in 2011. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/015.